Environmental Science and Policy 82 (2018) 60–70

Contents lists available at ScienceDirect

Environmental Science and Policy

journal homepage: www.elsevier.com/locate/envsci

Perceived citizens' satisfaction with climate change stakeholders using a multicriteria decision analysis approach

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ARTICLE INFO

Keywords:
Climate change
Citizen satisfaction
MUSA (MUlticriteria Satisfaction Analysis)
Stakeholders
Public opinion

ABSTRACT

The current need to adjust to the climate change requires urgent action to be taken both by the stakeholders involved in addressing climate change and by citizens. However, in order for citizens to be able to take part in such actions directly or indirectly, they will need to have a positive perception of the relevant stakeholders, so that a mutual relationship of trust and understanding is established. The objective of this study is to examine citizen satisfaction with the actions of the stakeholders involved in climate change. The study was conducted in Greece using a structured questionnaire; 1536 questionnaires were collected from January 2014 to June 2015 and the relevant data were processed using the MUSA method (MUlticriteria Satisfaction Analysis). The results of the study show that the citizens are not particularly satisfied, mainly with the actions of the governmental authorities involved in addressing climate change. In order to motivate citizens to take part in such actions in future, the relevant governmental bodies will need to increase their involvement and substantially improve their actions regarding the reduction of pollutants from industry and business, the level of civil protection and information provision, as well as public awareness and education on climate change.

1. Introduction

In recent decades, the environmental problems that the global community has been tackling have been a source of great concern for the scientific community and relevant stakeholders. One of these problems is climate change (Hansen, 2011), which is one of the greatest challenges that mankind has ever faced (Manolas, 2015). Young people, in particular, will face its impact throughout their life, and will also be society's future decision-makers on issues of vital importance (Körfgen et al., 2017). Climate change, however, does not simply constitute an environmental issue, but is also inextricably linked to development, both on a personal and socio-political level, with citizens having to make great efforts as regards its future outcome (Lorenzoni and Pidgeon, 2006).

There are various restrictive factors which play a relevant role: a) the development of diverse policies and strategies, b) the various ideologies expressed by country leaders (McCright et al., 2016), c) the promotion of debates and scientific information on climate change in various contexts (Boykoff and Goodman, 2015), d) the ever-changing values and intentions which require harmonization with socio-environmental models (Piperopoulos and Tsantopoulos, 2006; Voinov et al., 2014), e) the nature of the static phenomenon of climate change which cannot be directly perceived (Weber, 2016), and f) the failure of the mass media to portray and elaborate on issues related to climate change, in conjunction with the independent variables (gender, age, education and religion) which affect citizens' views (Clements, 2012).

The said views, which differ in each geographical region, combined with the low level of public information (Lorenzoni and Hulme, 2009), a low educational level, the ignorance of the related risks, as well as the economic decline countries are suffering, have resulted in decreased concern for climate change in recent times by the public, compared to the past.

Environmental communication, through its methods, models and policy strategies, can play a significant role in tackling this problem by mobilizing the participation of various stakeholders and citizens in actions on climate change that will also contribute to sustainable development. It has the ability to combine environmental issues with citizen communication, and is affected by several factors, such as the mass media, which can easily influence the views, attitudes and perceptions of citizens on various issues, including environmental problems (McCallum et al., 1991; Greenberg and Chess, 1992; Liebler and Bendix, 1996; Stamm et al., 2000; Williams, 2000; Bengston et al., 2005; Pollak and Zint, 2006; Skanavis and Sakellari, 2007), through their direct promotion. Another major factor is the citizens' satisfaction

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https://doi.org/10.1016/j.envsci.2018.01.008
Received 26 November 2017; Received in revised form 11 January 2018; Accepted 12 January 2018
Available online 03 February 2018
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from the actions undertaken by stakeholders in dealing with this phenomenon. Citizen satisfaction is a term linked to the trust shown by citizens in stakeholders, and is required if the former are to get involved in actions related to climate change.

Therefore, the goal of this study is to define the criteria that affect global citizen satisfaction and pinpoint potential improvement actions. For this reason, a first step will be to identify the stakeholders with whom the citizens are particularly satisfied or dissatisfied, as regards their actions concerning climate change; secondly, to present any further actions and improvements that are required for citizens to be motivated to participate. In this way, an attempt will be made to identify the decision-making bodies that citizens consider to be of most importance, and to actually measure citizens' satisfaction with actions undertaken by the state, with the aim to find the optimum scope for action and action improvement that will increase the citizens' satisfaction and trust, and urge them to participate in such actions in future.

The aforementioned holistic approach is the main contribution of the present paper, given the limited efforts made by previous studies that mainly focus on a simple measurement approach. In addition, the application of a multicriteria decision analysis approach, which can effectively analyze collected ordinal data, also constitutes an important contribution of this study.

2. Background

Climate change has been at the focus of global environmental problems, mainly since the Kyoto Protocol came into effect and recently with the Paris Agreement, which has a binding obligation to achieve zero global carbon emissions at a future date (Uitto et al., 2017); it has become a major environmental issue both for the scientific community and for governments, and also for the mass media which exert a direct influence on society. Nevertheless, following the signing of the Protocol, governments have implemented various policy strategies regarding climate change, without paying particular attention to raising awareness and educating the public as regards the need to adapt to these new changes.

Thus, after the signing of the Protocol and a period of intense concern, polls now show that the citizens' concern regarding climate change has decreased; such public opinion is influenced, in general, by weather conditions, socio-economic factors and policy actions (Capstick et al., 2015), regardless of political leanings (Guber, 2013).

According to the World Bank (2010), the majority of citizens (59.0%) globally regard the climate change as an issue of primary importance, whereas a small percentage (3.0%) does not consider it important. The level of concern is highest amongst Canadian citizens, followed by Europe and South America (Bord et al., 1998). Nevertheless, most citizens consider climate change to be of secondary importance, compared to other types of problems (Lorenzoni and Pidgeon, 2006). The reduced levels of concern among citizens regarding climate change (GlobeScan, 2013), according to Scruggs and Benegal (2012), are probably related to the gloval economic decline, and the deficient labor market; these levels of concern are expected to rise only when the two above-mentioned parameters present some improvement. Obani and Gupta (2016) make the same observations and believe that, during an economic crisis, citizens tend to focus their attention on economic recovery, rather than on climate change, since they are convinced that by making environmental issues a priority they are hampering the recovery of the economy.

Thus, in a poll conducted in Europe in 2002, climate change was placed in the second major category of environmental problems, with a total level of concern amounting to 39.0%. The highest level of concern regarding climate change was recorded in Greece (63.0%), compared to countries such as Luxemburg (50.0%), Italy (49.0%), Portugal (47.0%), France and Germany (44.0%) and Austria (39.0%). The other European countries presented lower levels ranging between 21.0% and 29.0% (EORG, 2002). In the same year, it was also found that most European citizens were similarly worried about future changes to the climate and presented more or less the same average rate of concern (Lorezoni and Pidgeon, 2006). Over the next years, climate change was also viewed by European citizens as the main problem for Europe (57.0%), in contrast to 2004, when the percentage was 45%, and Europe considered water pollution to be its number one problem (47.0%) (European Commission, 2007). In 2008, climate change was deemed to be the second most important problem (62.0%) in Europe, while poverty was at the top of the list (68.0%) (European Commission, 2008). The same results were obtained during the economic crisis (2013), when climate change moved to the third place (50.0%), compared to the results of 2011 (51.0%). On the contrary, the number of citizens who considered the economic situation as the second most important problem for Europe (45.0%) and poverty as the first (64.0%) increased in 2013 to 58.0% and 76.0% respectively (European Commission, 2013).

In Greece, which is undergoing a period of economic decline, it was found that nine out of ten citizens (87.0%) consider the climate change to be a very important problem; a higher rate than the average of all European countries. When compared to other major problems, Greek people consider poverty to be the main problem of Greece, while climate change is in fourth place (48.0%) (European Commission, 2015).

In order to raise the levels of concern among citizens regarding climate change, so as to address the problem and ensure the citizens' participation in relevant actions and their adaptation to the new changes, several states have tried to carry out action plans on a national and local level, which, however, have not led to substantial results. Finland, the United Kingdom, and Italy were some of the first countries that published strategic adjustment plans regarding the impact of climate change, while other European countries also developed similar successful programmes and applied strategic adjustment policies aiming at the adoption of relevant measures. Some of the latter involved adjustments in forest management due to climate change were addressed at the forest owners of Portugal, Germany and Sweden (Blennow et al., 2012). In the USA, strategic adjustment policies were used to study the level of concern among farmers regarding the effects of climate change (Arbuckle et al., 2014) and how to minimize the irrigation of agricultural land by farmers, through programmes implemented by the Ministry of Agriculture using alternative forms of new technology irrigation systems in order to reduce soil and drought vulnerability (Carrico et al., 2015). Moreover, although certain actions were carried out in Brazil, mainly to mitigate gas emissions, the government's intervention was insufficient and there is limited capacity to adjust to the climate change (Martins and Ferreira, 2011). In addition, in California (USA), the government has extensively focused on the exchange of information, impact assessment and programming issues (Davis and Chornesky, 2014). At the same time, certain cities in Germany and the United Kingdom developed action plans involving strategies mainly related to the energy sector, but these were abandoned due to financial constraints (Bulkeley and Kern, 2004). The same situation was observed in Greece, where the national strategy for adjustment to climate change (2016) was delayed due to the economic decline.

In such cases however, according to Gillard et al., (2016), decision-makers will need to overcome any constraining factors and turn to other stakeholders offering alternative means of impact and innovation, as well as opportunities for effective action. Moreover, apart from the interaction between economic and social values, the moral question regarding the rights of future generations and the responsibilities of today's generations has not yet been resolved either (Howarth and Norgaard, 1992). On the contrary, there are disputes with regards to nature, environmental ethics and the importance of the actual needs that arise (Morrow, 2015). This is obviously due, on the one hand, to the unforeseen economic impact of the climate change and the complex issue of the inherent element of uncertainty involved (Kang and Banga, 2013) and, on the other hand, to the fact that future provisions are

greatly lacking as regards the adoption of stricter climate policies.

It is for this reason therefore, that the phenomenon of climate change and the efforts to stabilize sustainable development should not be dealt with in isolation, as is usually the case (Swart et al., 2003); there should be a restructuring of the goals of policy-making that will make a distinction between responsibility and action (Banuri and Opshoor, 2007). This will require a balanced perspective that will take into account the impact of climate change on sustainable development and its effect on areas vulnerable to changes in climatic conditions, both from an environmental and a social perspective (Wilbanks, 2003). For this to happen, a combination of the factors that affect the citizens' views on climate change will need to be in place, which may potentially reduce the level of political, economic and social action required to deal with these particular risks (Leiserowitz, 2005). Thus, policies will need to focus on the social and institutional barriers which limit the participation of the public in addressing this problem (Bulkeley, 2000). Initially, since uncertainty and knowledge do not constitute an immediate obstacle for action (Zajko, 2011), there will need to be a shift of focus from the disparities that exist between the various policies on climate change to the willingness of citizens to take part in such actions, which is however influenced by the public views and perceptions, stemming from their daily local experiences (Barr and Gilg, 2006).

For this purpose, the policy strategies for dealing with the effects of climate change will need to focus not only on the international but also on the national models of climate protection (Bulkeley and Kern, 2006). As some of the most important stakeholders in policy-making for climate change (Boehmer-Christiansen, 1994) on a national level, governments could take an active role in addressing climate change, since they are considered by the majority of European citizens (48.0%) as the main stakeholders linked to climate change (European Commission, 2013), with a primary role in the global governance of the environment through the formation of international alliances and their operation on a national scale (Bulkeley and Betsill, 2005). Next, the main stakeholders named were the industry and business (41.0%), the European Union (39.0%), citizens (25.0%), the local authorities and environmental organizations (19.0%) (European Commission, 2013). In a similar manner, in Greece it was found that six out of ten Greek citizens (67.0%) believe that the government has the greatest responsibility for dealing with climate change, followed by business and the industry (55.0%) and the European Union (45.0%) (European Commission, 2015).

At the same time, on a local level, the local authorities are viewed as the main stakeholder involved in taking action for climate change, since they are able to promote the required actions and reduce emissions, while working together with the local communities (DETR, 2000). European citizens (19.0%) put them in fourth place, while Greek citizens (29.0%) attribute a higher level of responsibility to them (European Commission, 2015).

The result of this fact is that most leaders do not perceive the importance of the climate and its future impact, and more efforts are required to connect the knowledge of its impact with local networks and public opinion (Keys et al., 2016). It has been observed that many cities do not exploit the available options as regards the implementation of measures regarding climate change, due to internal coordination problems and lack of political support from the local authorities (Kern and Alber, 2009). On the contrary, the bodies which perceive the impact and changes related to the climate are willing to act but limit themselves to specific actions, avoid implementing a systematic strategy and give up when they face economic difficulties. Since the actions on climate change are inextricably linked to sustainable development and the economic situation of each country or each local government, it has been observed, according to Victor (2001), that instead of the situation improving, the past trend of "selective development" is now being pursued, which involves the implementation of specific rates of development depending on the direct or indirect emissions of greenhouse gases.

3. Methodology

3.1. Study area

The study area was the whole of the Greek territory, whose population according to the most recent census of the Hellenic Statistical Authority (EL.STAT) (2011) amounts to 10,815,197 people, of which 49.2% are men and 50.8% are women. In recent decades, the country's economy has been mainly based on the tertiary sector. In Greece, particular features of the climate change have been observed, since it is one of the most vulnerable geographic regions in the Mediterranean, which is currently being affected and is due to suffer an even greater impact from the climate change in future. Each of its regions is equally important to study as regards climate change, since its geographic profile (continental, mountainous, and coastal) means that each region will be affected on a different scale. As a result, the local residents have varied perceptions of the relevant risks, which may affect their views and attitudes and, due to this substantial difference, a sample was selected from all geographic regions of Greece.

3.2. The survey questionnaire – survey sample

The presented survey is part of a larger research which examines the views, attitudes and knowledge of citizens regarding climate change. More specifically, the study was conducted using an extensive closed-type questionnaire, which consisted of two parts. The first part refers to the satisfaction and trust of citizens in the actions undertaken by stakeholders to address the climate change, while the second part refers to the citizens' demographic data (age, education, family status, profession, population in residence area). The questions are set out in a simple, easy-to-understand manner, since we are addressing all citizens, regardless of educational level, age, and geographic region. Therefore, the questions involve all citizens and concern their views, attitudes and knowledge on climate change. Prior to the start of the survey, a qualitative pilot study was conducted in order to determine the citizen satisfaction criteria that should be included in the questionnaire.

The sampling method used is based on a simple random approach, due to its simplicity and the fact that it requires the least possible knowledge of the population compared to any other method (Damianou, 1999; Kalamatianou, 2000; Matis, 2001). The "population" under study includes all households in Greece. The use of households is a classic example of using a group of people as a sampling unit, instead of individuals. This is done because in certain cases it is a more convenient and less costly option (Matis, 2001). In fact, the process of selecting a member (of the randomly selected household) was organized in a way that ensured that the same member (i.e., the head of the family or the wife) would not always be chosen (Filias et al., 2000).

The sample size was estimated based on the formulae of simple random sampling (Freese, 1984; Kalamatianou, 2000; Matis, 2001). Although simple random sampling without replacement was used, the finite population correction can be ignored, since the sample size n is small in relation to the size of the population N (Pagano and Gauvreau, 2000).

$$n = \frac{t^2 \cdot \overline{p} \cdot (1 - \overline{p})}{e^2} = \frac{1.96^2 \cdot 0.50 \cdot (1 - 0.50)}{0.025^2} \approx 1536 \quad (1)$$

where t = the value of the Student distribution for probability $(1 - \alpha) = 95\%$ and $n - 1$ degrees of freedom. Since the size of the conducted pre-sampling is big (over 50), the t value is obtained from the tables of the normal distribution for the desired probability. In practice, for probability 95% the value is 1.96 (Matis, 2001). p = the proportion estimate and e = the maximum allowable difference between the sample mean and the unknown population mean. We assume that it is 0.025, i.e. 2.5%.

To estimate the size of the sample, it was necessary to conduct a pre-sampling, on a small set of 50 persons. In this way, the actual

proportion of the population was estimated for each variable. The use of a questionnaire is not limited to the estimation of only one population variable. Thus, we need to estimate the size of the sample for each of the variables. The variable which produced the largest sample size is "gender" (50.0% men and 50.0% women). If the estimated sample sizes are similar and all of them are consistent with the available financial resources of the sampling, then the maximum is selected as the sample size. In this way, the variable presenting the largest variance is estimated with the desired accuracy, while the rest with a higher accuracy than initially determined (Matis, 2001).

3.3. The MUSA method

Next, the analysis of the criteria followed, which was carried out using SPSS (version 16.0) for the analysis of the descriptive data and the MUSA (MUlticriteria Satisfaction Analysis) method in order to analyze citizen satisfaction.

The MUSA (MUlticriteria Satisfaction Analysis) method is a preference disaggregation model that follows the principles of ordinal regression analysis (Grigoroudis and Siskos, 2005). It follows a multicriteria aggregation-disaggregation approach as regards the problem of measuring and analyzing satisfaction (Siskos et al., 1998; Grigoroudis and Siskos, 2005; Grigoroudis et al., 2002; Grigoroudis et al., 2008; Arabatzis and Grigoroudis, 2010; Manolitzas and Yannacopoulos, 2013).

This original methodology is based on multicriteria decision analysis and adopts the basic principles of the aggregation-disaggregation approach and the theory of value or utility systems (Grigoroudis and Siskos, 2005). By measuring citizen satisfaction, it offers direct, substantial and objective feedback regarding the preferences and expectations of the public (Grigoroudis and Siskos, 2005).

More specifically, the MUSA method follows the general principles of ordinal (non-monotone) regression, using linear programming techniques (Jacquet-Lagrèze and Siskos, 1982; Siskos and Yannacopoulos, 1985; Siskos, 1985; Grigoroudis and Siskos, 2005). The method estimates an additive global value function Y^* and a set of partial satisfaction functions X_i^* (for each satisfaction criterion i). The main objective of the method is to achieve the maximum possible consistency between the value function Y^* and the citizens' judgments Y (Grigoroudis and Siskos, 2005; Arabatzis and Grigoroudis, 2010).

Based on the ordinal regression analysis equation, and introducing a double error variable, the ordinal regression analysis equation takes the form:

$$\widetilde{Y}^* = \sum_{i=1}^{n} b_i X_i^* - \sigma^+ + \sigma^- \tag{2}$$

where $\widetilde{Y}^*$ is the estimation of the collective value function Y^*, n is the number of criteria, b_i is the weight of the i-th criterion, and σ^+, σ^- are the overestimation and underestimation errors, respectively. It should be noted that Y^* and X_i^* are monotone functions normalized in [0,100].

Within this framework, the problem of evaluating citizen satisfaction can be formulated as an optimization problem by using goal programming, and thus the estimation model be written using a linear programming formulation as follows (Grigoroudis et al., 2007; Manolitzas et al., 2014a,b):

$$\begin{cases} [\min] F = \sum_{j=1}^{M} \sigma_j^+ + \sigma_j^- \\ \text{subject to} \\ \sum_{i=1}^{n} \sum_{k=1}^{x_i^j - 1} w_{ik} - \sum_{m=1}^{y^j - 1} z_m - \sigma_j^+ + \sigma_j^- = 0 \text{for} j = 1,2,...,M \\ \sum_{m=1}^{\alpha - 1} z_m = 100 \\ \sum_{i=1}^{n} \sum_{k=1}^{\alpha_i - 1} w_{ik} = 100 \\ z_m, w_{ik}, \sigma_j^+, \sigma_j^- \ \forall \ m, i, j, k \end{cases} \tag{3}$$

Where M is the citizen sample, while y^j and x_i^j are the overall and partial satisfaction judgments by citizen j. In addition, the following transformation equations are used for the decision variables of the previous linear program:

$$\begin{cases} z_m = y^{*m+1} - y^{*m} & \text{for } m = 1,2,..., \alpha - 1 \\ w_{ik} = b_i x_i^{*k+1} - b_i x_i^{*k} & \text{for } k = 1,2,..., \alpha_i - 1 \text{ and } i = 1,2,..., n \end{cases} \tag{4}$$

where y^{*m} is the value of the satisfaction level y^m, x_i^{*k} is the satisfaction value of x_i^k, while α and α_i are the number of partial and global satisfaction levels, repectively (Grigoroudis et al., 2007, Manolitzas et al., 2014a, 2014b).

The MUSA method is able to produce a large variety of results. One primary result involves the criteria weights, as well as a series of normalized indices that can help analyze the problem of evaluating citizen satisfaction (Grigoroudis and Siskos, 2005). These results also provide the action and improvement diagrams.

3.3.1. Weights of criteria and average indices

- ***Weights of criteria/sub-criteria*:** the weights of the criteria show the relative importance according to a set of criteria or sub-criteria (Mihelis et al., 2001) that a group of citizens assigns to the satisfaction dimensions (Grigoroudis and Siskos, 2005).
- ***Average satisfaction indices*:** these indices have a range of 0–1 and can be considered as the main performance indices (Manolitzas and Yannacopoulos, 2013), since they present the citizens' degree of satisfaction in a simple manner and combine the results of the MUSA method with the results of descriptive statistics (Grigoroudis and Siskos, 2005).
- ***Average demanding indices*:** these indices are normalized in the interval [-1,1], calculated using the curves of the estimated added value functions (Manolitzas and Yannacopoulos, 2013); they define a variable based on the degree of demanding, by fully exploiting the information provided by the satisfaction functions (Grigoroudis and Siskos, 2005).
- ***Average improvement or effectiveness indices*:** the average improvement indices are normalized in the interval [0,1] and show the improvement potential of a specific criterion (Grigoroudis and Siskos, 2005; Manolitzas and Yannacopoulos, 2013).

3.3.2. Action and improvement diagrams

3.3.2.1. Action diagrams. Action diagrams constitute performance-importance maps, and are often referred to as strategy maps (Customers Satisfaction Council, 1995; Dutka, 1994; Naumann and Giel, 1995; Grigoroudis and Siskos, 2005). They can be developed by combining the weights of the satisfaction criteria with the average satisfaction indices. They are divided into four quadrants depending on the performance (satisfaction) and importance of the criteria. Each quadrant corresponds to a specific area of action for which the implementation of a set of actions is required (Fig. 1). More specifically (Grigoroudis and Siskos, 2005):

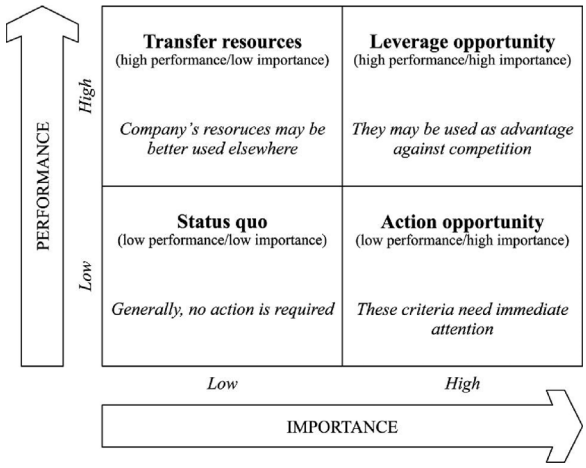

Fig. 1. – Action diagram (Customers Satisfaction Council 1995; Grigoroudis and Siskos 2002; Grigoroudis and Siskos 2005).

- **Status quo** (Low performance/Low importance), no action required.
- **Leverage opportunity** (High performance/High importance), actions are required only when there is improvement potential.
- **Transfer resources** (High performance/Low importance), which includes criteria which are not particularly critical for improvement, but they constitute future threats and
- **Action opportunity** (Low performance/High importance), which includes important satisfaction criteria with relatively low performance (satisfaction), and thus they require attention.

3.3.2.2. Improvement diagrams. They are constructed according to the average demanding and effectiveness indices in order to define the improvement priorities (Fig. 2). They are also divided into 1st, 2nd and 3rd priority quadrants (Grigoroudis and Siskos, 2002):

- **1st Priority** (High effectiveness/Small effort): It involves direct improvement actions which are particularly effective given that citizens are not demanding in these specific criteria.
- **2nd Priority** (High effectiveness/Large effort and Low Effectiveness/Small effort): This category includes the satisfaction criteria which either have a low demanding index or a high improvement index.
- **3rd Priority** (Low effectiveness/Large effort): It refers to criteria which have a low improvement potential and require substantial improvement efforts.

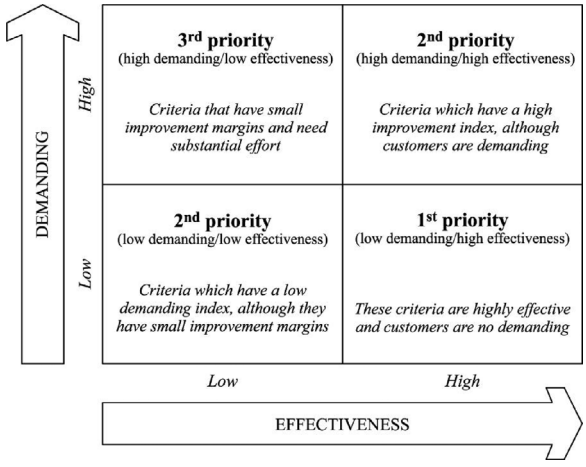

Fig. 2. – Improvement diagram (Grigoroudis and Siskos 2002; Grigoroudis and Siskos 2005).

3.4. Satisfaction criteria

The main criteria set for analyzing citizen satisfaction concern the stakeholders involved in dealing with climate change. A separate part of the questionnaire examines the satisfaction from the related actions which the state has already undertaken or plans to undertake. Thus, the main criteria are (i) Global community: this criterion presents the citizens' satisfaction with all major stakeholders involved in tackling climate change on a global scale, (ii) the State: this criterion refers to the satisfaction felt by citizens as regards both the government and the support mechanisms of the state structures dealing with this specific environmental problem, (iii) Local authorities: it determines the citizens' satisfaction with stakeholders in dealing with problems for which the local competencies lie with municipalities, communities etc., (iv) Environmental organizations: it mainly refers to the citizens' satisfaction with the actions of private organizations which aim at tackling the effects of climate change, (v) Non-governmental organizations: with this criterion, citizens evaluate the actions on climate change undertaken by organizations which are not dependent on the state and mainly promote European environmental management programmes related to climate change, (vi) Scientists: this criterion expresses the citizens' satisfaction with the research, knowledge and actions stemming mainly from the academic circle of public universities and technological institutions, but also from self-employed professionals who implement scientific environmental programmes, (vii) Local environmental citizen groups: in this criterion, citizens evaluate the actions on climate change which are implemented by citizen groups, which are keen to participate in actions which tackle environmental problems and (viii) Citizens: this criterion measures the satisfaction of citizens with their fellow citizens who individually try or take part as volunteers in actions addressing climate change.

The satisfaction level of all criteria is measured on a 5-point ordinal Likert scale with the following format: completely dissatisfied, dissatisfied, neither satisfied nor dissatisfied, satisfied, completely satisfied.

4. Results

4.1. Citizens' profile and descriptive characteristics

The socio-demographic characteristics of the sample show that the women outnumber the men, while the majority of the sample is aged mainly 18–30 or 41–50 years, with a much smaller number who are aged 51 years and above. As regards the educational level of interviewed citizens, most are secondary (35.4%) or tertiary education graduates (45.9%), while a relatively small number have postgraduate degrees, or have completed technical or compulsory education. In addition, the majority of the interviewees are civil servants (28.3%), private employees (16.4%) or self-employed professionals (13.2%); there is a smaller number who are involved in primary production (agriculture and animal breeding) or housekeeping. There is also quite a high percentage of citizens in the sample, approximately 15.5%, who are unemployed. Moreover, most of the citizens (29.2%) in the sample live in cities with a population of over 100,000 inhabitants, while there is also a significant number of citizens who live in provincial towns, with a population of under 15,000 inhabitants.

The results of the survey on the stakeholders involved in dealing with climate change are not particularly satisfactory (see Table 1), since most citizens are neither satisfied nor dissatisfied with the actions taken by stakeholders to address the problem; there is also a significant number of citizens who say they are completely dissatisfied or dissatisfied with their actions.

A similar level of satisfaction was expressed by citizens regarding the effectiveness of actions on climate change that have been carried out by scientists. While the majority of citizens adopt a neutral stand regarding the actions undertaken by scientists (49.3%), a smaller

Table 1
– Citizen satisfaction rates with stakeholders on the actions they have undertaken to address the problem of climate change (%).

Criteria	Completely dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Completely satisfied
Citizens	7.0	29.0	48.5	14.3	1.2
Local environmental citizen groups	4.6	20.0	46.7	27.3	1.4
Non-governmental organizations	6.6	19.5	43.2	28.6	2.1
Environmental organizations	3.1	13.0	38.3	41.8	3.8
Scientists	3.8	17.1	49.3	27.1	2.5
Local authorities	17.4	41.5	32.9	7.6	0.6
State	27.8	47.2	22.0	2.6	0.4
Global community	16.1	35.1	40.0	8.3	0.6
Global Satisfaction	8.9	27.4	48.7	14.3	0.7

percentage is either completely satisfied (2.5%) or satisfied (27.1%) with their actions. At the same time, a particularly important part of the sample, higher than that related to environmental organizations, remains completely dissatisfied or dissatisfied by the actions in question. This result is obviously due to the lack of satisfaction among citizens regarding the actions of the scientific community, and at the same time shows that the scientists will also have to make greater efforts in order to increase the citizens' degree of satisfaction with their actions. Similar results with only minor differences are also observed regarding the actions undertaken by local environmental citizen groups, with the majority of citizens (46.7%) taking a neutral stand regarding the effectiveness of the actions they implemented. In addition, similar results were obtained regarding citizen satisfaction with the actions undertaken by non-governmental organizations (NGOs); a lower level of satisfaction was linked to actions that their fellow citizens have implemented, in order to address or minimize the problem of climate change. In addition, the interviewees' state that they are more satisfied (28.6%) with non-governmental organizations than with their fellow citizens (14.3%), which shows that they consider the actions taken by the former to be more important compared to the latter's actions.

On the contrary, the results of the actions on climate change of stakeholders, such as the global community, local authorities and the state, were not particularly satisfactory. Most citizens are completely dissatisfied or dissatisfied with the actions they have undertaken, a large number are uncertain about the effectiveness of their actions and a very small number of citizens are completely satisfied or satisfied with their actions.

These results confirm the dissatisfaction of citizens with these particular stakeholders and by extension their dissatisfaction with the state; they also point to the immediate improvements that must be implemented, so that the citizens' degree of satisfaction with their actions increases. This is particularly important, since it may be a critical motivation factor for citizens' perceptions and actions against climate change.

4.2. Analysis of citizen satisfaction with climate change stakeholders

A citizen satisfaction analysis was conducted using the MUSA method in order to initially examine the degree of citizen satisfaction with the stakeholders' actions against climate change. The survey examined the stakeholders which must take or improve their actions further in order for citizens to participate in actions on climate change. Each result from the MUSA method, as for example in Table 2, includes the weights and the average satisfaction indices, which are the basic result used to interpret the overall satisfaction of citizens. The relevant results show that citizens are not very satisfied with stakeholders undertaking actions on climate change. Therefore, if the stakeholders take steps to potentially increase the citizens' degree of satisfaction that would also increase the citizen participation in actions on climate change. This means that if the various stakeholders involved in tackling climate change are interested in increasing the citizens' degree of satisfaction, they will need to improve their actions to a great extent.

Table 2
– Criteria weights and average indices of global citizen satisfaction with stakeholders in relation to citizen participation in actions.

Criteria	Weights (%)	Average Satisfaction Indices (%)
1. Citizens	12.56	22.30
2. Local environmental citizen groups	12.50	26.65
3. Non-governmental organizations	10.74	28.89
4. Environmental organizations	8.35	42.41
5. Scientists	9.84	32.61
6. Local authorities	12.50	16.21
7. State	20.99	7.73
8. Global community	12.50	17.45
Global Satisfaction		21.85

More specifically, Table 2 points to the following:

1) The global citizen satisfaction index for stakeholders who have undertaken actions on climate change is relatively low. Thus, the citizens are only slightly satisfied with the actions of stakeholders and the latter will potentially need to improve or implement different actions in order to satisfy the citizens and urge them to participate in future actions. The citizens present relatively higher satisfaction indices for non-governmental bodies (42.41%), and lower satisfaction indices for governmental bodies, such as the state (7.73%), local authorities (16.21%) and the global community (17.45%).
2) On the contrary, citizens place more importance on governmental bodies, such as the state, the local authorities, and the global community, for which they present low satisfaction indices, which directly affect the overall level of satisfaction. At the same time, they present similar weights for environmental citizen groups (12.50%) and for citizens (12.56%), for which the satisfaction indices are higher.
3) As expected, the citizens are more demanding with the stakeholders, with whose actions they are not satisfied regarding climate change. They consider the state, the citizens, the local authorities, the global community, and the local environmental citizen groups to be the most important bodies.

4.3. Action and improvement diagrams of citizen satisfaction regarding actions undertaken by stakeholders on climate change

In order to increase the degree of citizen satisfaction with the actions of stakeholders on climate change, the latter will need to further enhance and improve their actions. This fact can also be observed from the results of Table 2 and the action and improvement diagrams elaborated for these stakeholders. In general, we can observe the following (Fig. 3):

- The action opportunity (low performance/high importance), which involves the priority classification for improvement of actions,

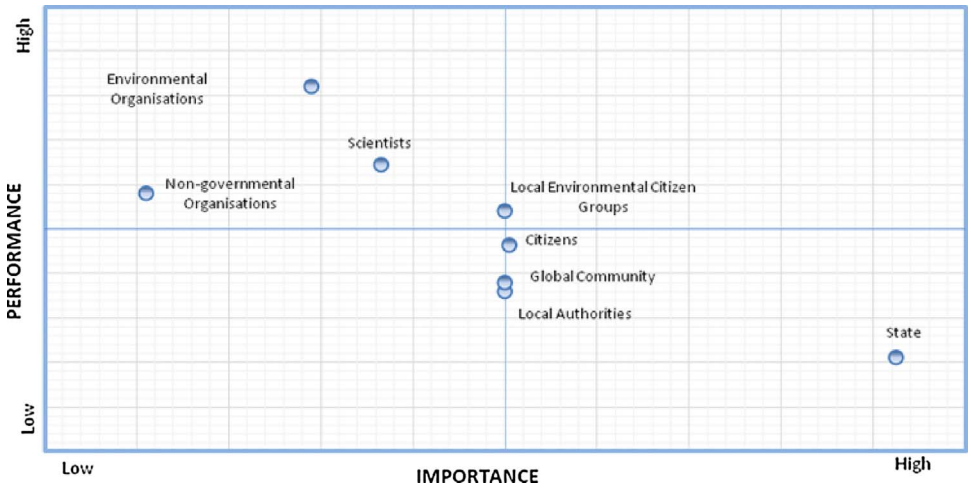

Fig. 3. – Action diagram of citizen satisfaction with the actions undertaken by stakeholders regarding climate change.

includes the stakeholders with the lowest satisfaction ratings and the highest weights. It features stakeholders such as the state, the local authorities, and the global community, which directly affect the citizens' level of satisfaction, and with whose actions the citizens are not satisfied.

- Local citizen groups and citizens are located in the vertical axis, which means it is difficult to categorize them in a quadrant; these however are important criteria for monitoring in the future.
- Environmental organizations, NGOs and Scientists are the last priority for action; the citizens are relatively more satisfied with the actions of these stakeholders. They do not affect the level of satisfaction and can constitute major points for action in future.

The improvement diagram (Fig. 4) shows that the stakeholders are limited to the second and fourth quadrant, thus creating an empty diagram. This is due to the gap that exists between citizens and stakeholders. At the same time, there are no stakeholders in the first quadrant which need to immediately improve their actions.

- The second quadrant (2nd Priority), as expected, includes the stakeholders with whom there is the greatest dissatisfaction; the interviewees appear to be the most demanding as regards the actions of these stakeholders. Therefore, these bodies will need to make greater efforts to improve their actions in order to increase citizen satisfaction. The same is also valid for the environmental citizen groups. Although the citizens present a higher satisfaction index compared to the other stakeholders, the interviewees are equally demanding as regards their actions.
- The fourth quadrant (3rd Priority), includes the stakeholders of whom the citizens are very demanding; they present a low effectiveness and therefore require great efforts for improvement. They are the final improvement priority.

4.4. Action and improvement diagrams for the actions undertaken by the state to deal with climate change

The citizen satisfaction analysis on the actions undertaken by stakeholders regarding climate change showed that citizens are particularly dissatisfied with the actions undertaken by the state (Table 3). In addition, the state, according to the above-mentioned action and improvement diagrams, is the body that will need to take the most action and improve existing actions in order to raise the citizens' level of satisfaction and urge them to also take part in actions regarding climate change.

For this purpose, and in order to examine the gap between the actions undertaken by the state to tackle climate change and citizens' expectations, a number of potential actions were analyzed that the state has already undertaken or will undertake in order to tackle this phenomenon. Thus, through the questionnaires, citizens were asked to express their satisfaction with each of the said actions, in order to identify the actions with which the citizens are most satisfied, but also the actions with which they are dissatisfied and which will need to be further improved by the state.

The findings show that the state will need to make greater efforts overall, since none of the actions was awarded a high level of satisfaction. The same finding was also observed through the action and

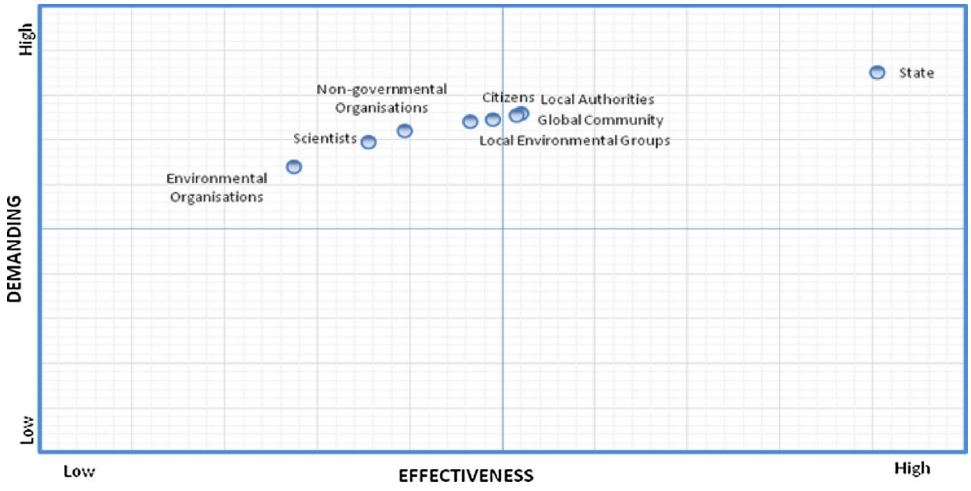

Fig. 4. – Improvement diagram of citizen satisfaction with the actions undertaken by stakeholders regarding climate change.

Table 3
–Weights of criteria and average indices of overall citizen satisfaction for the actions undertaken by the state to deal with climate change.

Sub-criteria	Weights (%)	Average Satisfaction Indices (%)
Reduction of greenhouse gases emitted by industry and business	8.98	13.69
Fumes emitted by private cars	8.87	20.20
Improved services and modernization of public transport	9.09	20.99
Waste management	9.09	18.32
Civil protection from extreme weather phenomena	10.15	13.60
Construction of public works that help to address the problem	9.09	16.54
Use of alternative forms of energy	7.71	23.18
Construction of and subsidies for energy efficient housing	7.84	23.08
Public awareness on climate change and its impact	10.23	14.43
Public education through lessons on climate change	9.09	14.36
Adult education on climate change	9.82	12.35
Global Satisfaction		14.54

improvement diagrams.

In general, the action diagram in Fig. 5 showed that greater efforts will have to be made concerning the majority of the actions, since these are found in the first two quadrants, which have a direct impact for the citizens and directly affect the overall degree of satisfaction. The improvement diagram in Fig. 6 shows that there is a set of actions about which the citizens are particularly demanding and which require immediate improvement, and another set of actions which does not require immediate improvement but may prove to be of important in the near future, since they seem to have a direct impact on adjusting public opinion to the new state of affairs.

More specifically, Figs. 5 and 6 can be interpreted as follows:

- Initially, a set of actions undertaken by the state to tackle climate change can be found in the first quadrant of the action diagram (action opportunity) and is obviously a top priority for the state, given that the actions that belong to this quadrant are particularly important for citizens, who are not satisfied. These actions include civil protection from extreme weather phenomena, the reduction of pollutants from industry and business, adult education, raising awareness and educating the public on climate change and its impact; they also present the lowest satisfaction indices.
- A second set of actions found in the second quadrant (leverage opportunity), which involve the construction of public works, waste management, controlling the level of fumes emitted by cars, improved services and modernization of public transport, comprises the second priority of action by the state, since it also includes actions that are equally important to citizens. Furthermore, citizens are relatively more satisfied with these actions, but there are significant improvement margins.
- The fourth quadrant (transfer resources) includes two final actions that involve the use of alternative forms of energy and the construction of and subsidies for energy efficient housing. These actions come out last as regards priority actions to be undertaken by the state, since they present the highest level of satisfaction compared to the other actions and are not particularly important for citizens, since their performance is relatively high.
- In the improvement diagram, the actions are limited to the second (2nd Priority) and third (3rd Priority) quadrant, while the other two quadrants are empty, thus creating an important gap between the actions. This points to the fact that there is a gap between the actions requested by the citizens from the state and the actions offered by the latter.
- Due to this constraint, it is observed that the state will need to make a great effort to improve these actions, since the citizens are particularly demanding of the actions found in the second and fourth quadrant, which present a high and low effectiveness, respectively.

5. Discussion and conclusions

Climate change is regarded as quite a significant problem by European citizens, and more specifically by Greek citizens (European Commission, 2015); the majority considers the government to bear the greatest responsibility for climate change, rather than viewing it as an individual problem (European Commission, 2013; Smith et al., 2017). This can also be seen from the levels of the citizens' concern about the problem of climate change (Bord et al., 1998; EORG, 2002; Lorenzoni and Pidgeon, 2006; European Commission, 2007; European Commission, 2008; World Bank, 2010; European Commission, 2013; GlobeScan, 2013; Guber, 2013). It has however been observed that the citizens' concerns about climate change and the seriousness of the matter are gradually decreasing over time. This is obviously due to the global financial decline (Scruggs and Benegal, 2012; Obani and Gupta, 2016) and the economic crisis in Europe (Papoulis et al., 2015). It has been noted after all that the economic status of a country directly affects the views and attitudes of its citizens as regards environmental problems. Nevertheless, the stakeholders (mainly governmental bodies)

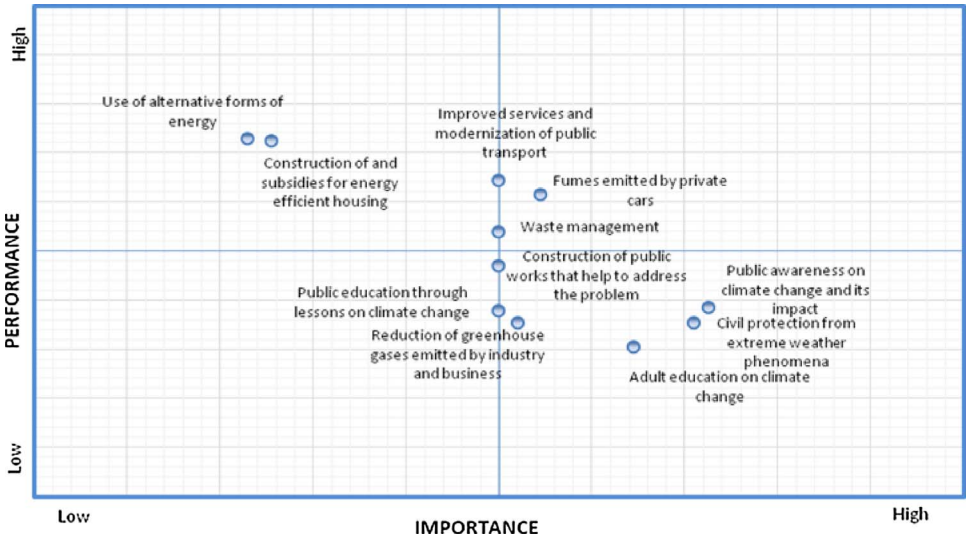
High
PERFORMANCE
Low
Use of alternative forms of energy
Construction of and subsidies for energy efficient housing
Improved services and modernization of public transport
Fumes emitted by private cars
Waste management
Construction of public works that help to address the problem
Public education through lessons on climate change
Reduction of greenhouse gases emitted by industry and business
Public awareness on climate change and its impact
Civil protection from extreme weather phenomena
Adult education on climate change
Low
IMPORTANCE
High

Fig. 5. –Action diagram of citizen satisfaction with the actions undertaken by the state on climate change.

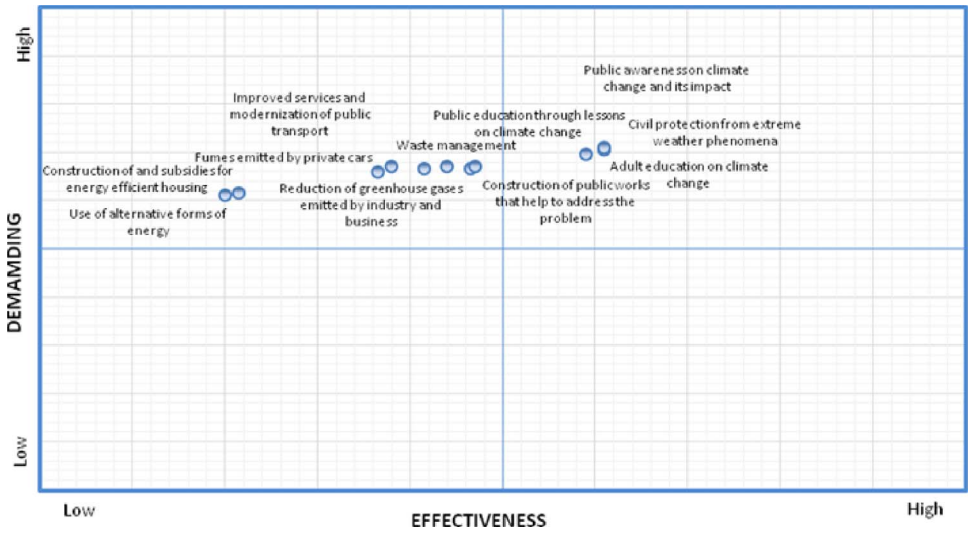
High
DEMANDING
Low
Low
EFFECTIVENESS
High
Public awareness on climate change and its impact
Improved services and modernization of public transport
Public education through lessons on climate change
Civil protection from extreme weather phenomena
Waste management
Fumes emitted by private cars
Adult education on climate change
Construction of and subsidies for energy efficient housing
Reduction of greenhouse gases emitted by industry and business
Construction of public works that help to address the problem
Use of alternative forms of energy

Fig. 6. –Improvement diagram of citizen satisfaction with the actions undertaken by the state on climate change.

that undertake actions to deal with climate change are the main factors which affect the attitudes and views of citizens as regards action-taking in this context, since they function as "catalysts" for the citizens' participation in actions concerning climate change adaptation.

It is considered therefore essential to examine the global and individual satisfaction of citizens with the various stakeholders. In particular the state, when involved in actions, which are taken for tackling climate change, must take under consideration the citizens opinion in order to enhance their level of satisfaction. In order to analyze citizen satisfaction, which can be regarded as the most reliable information for evaluating the performance (Arabatzis and Grigoroudis, 2010) of the stakeholders involved in dealing with climate change, the MUSA (MUlticriteria Satisfaction Analysis) method can be applied, through which it is possible both to analyze citizen satisfaction with the actions undertaken by stakeholders to address climate change, and to identify how we may improve their future actions.

The majority of Greek citizens is not particularly satisfied with the actions of stakeholders in dealing with climate change, and is actually displeased with the relevant actions; this may be due to the minor efforts made by stakeholders to act in order to address climate change. This conclusion is not only observed in Greece however, since a similar level of discontent was noted for the majority of citizens on a global (World Bank, 2010) and European level (European Commission, 2013). Nevertheless, a disturbing fact is that the level of dissatisfaction of Greek citizens towards the government is gradually increasing over time, with Greek citizens stating that governments bear the greatest responsibility for addressing climate change, at a higher percentage than all member states of the European Union (European Commission, 2015). Furthermore, several of them expressed their dissatisfaction with the actions of the local authorities, at a similar percentage to the figures presented by the European Commission (2015) and the global community. Another interesting outcome of the study was the dissatisfaction of Greek citizens with the actions undertaken by citizens, which was at a similar level to that of European citizens, who also do not believe that citizens do enough to tackle climate change (European Commission, 2008).

Further action will need to be taken by government stakeholders, less by local environmental groups and even less by non-governmental organizations (NGOs), scientists and environmental organizations in general. Nevertheless, almost all stakeholders will need to try and improve their actions, since significant improvement margins are observed; in fact, there was no stakeholder with whom the citizens were completely satisfied. The state is considered as the more important stakeholder by citizens, since it is the main body undertaking action in any country, and the main body involved in the international agreements on the climate (Bulkeley and Betsill, 2005; European Commission, 2013). Consequently, citizens place more emphasis on this stakeholder and have more expectations from its actions against climate change, in order to be urged to participate. Therefore, the state will need to act and further improve its actions, and also turn to innovative actions, while overcoming any restrictions that it faces (Gillard et al., 2016) regarding climate change. In addition, it may have to combine any future actions on climate change both on a national and local level with its planning for the country's sustainable growth (Swart et al., 2003). At the other end of the scale, citizens are mostly satisfied primarily with the actions of environmental organizations, which European citizens believe bear less of a responsibility (European Commission, 2013), then of scientists and finally of non-governmental organizations (NGOs), local environmental citizen groups and citizens in general.

There are many cases where policy strategies have been implemented to adapt to the new changes with no substantial results (Bulkeley and Kern, 2004; Martins and Ferreira, 2011; Blennow et al., 2012; Arbuckle et al., 2014; Davis and Chornesky, 2014; Carrico et al., 2015). In Greece however, although a national adaptation strategy has been elaborated, significant cutbacks have been made due to financial problems. For example, the construction of bicycle routes and critical infrastructure for protection from extreme weather phenomena have been stopped in every city. Of the actions undertaken by the state, Greek citizens are mostly satisfied with those regarding renewable energy sources, although they pay more heed to actions that involve protection from extreme weather phenomena and raising public awareness on the climate change. This conclusion is potentially related to the views of the global majority of citizens who believe that governments will need to increase the cost of energy consumption in order to urge citizens to use renewable energy sources more intensively (World Bank, 2010). It is also linked to the perceptions of the majority of European citizens (European Commission, 2013) and the majority of Greek citizens, who consider it very important for governments to set goals for the increased use of alternative energy forms (European Commission, 2015). In fact, studies conducted in Greece have shown that Greek citizens are not only sufficiently informed about renewable energy sources, but are also quite willing to invest in RES (Tsantopoulos et al., 2014) and consider the implementation of energy policy strategies to be of major importance, despite the financial crisis (Papoulis et al., 2015).

To conclude, if the European Union is not able to fully achieve its goals, it will continue to influence the global policy on climate change which involves all aspects of energy efficiency, renewable energy sources and gas emissions (Schreurs and Tiberghien, 2007). As a result,

if stakeholders do not strictly implement pollution control measures and do not exploit renewable energy sources for energy production in their own countries, then their actions will have a direct effect on global energy and economy, since pollution knows no borders.

For this purpose, stakeholders involved in action-taking on climate change, and primarily the state, will need to seriously take into account the application and improvement of actions, which are related to civil protection from extreme phenomena and the reduction of pollutants from industries. This will lead to the motivation of citizens and their to participation in actions and their adaption to the new environmental and socio-economical changes, since the impact of climate change is the greatest possible threat to the global economy today (Elliott, 2016).

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